LENGTH-WEIGHT RELATIONSHIP AND RELATIVE CONDITION FACTOR OF JUVENILE GOLDEN MAHSEER *TOR PUTITORA* (HAMILTON 1822), IN THE TRIBUTARIES OF RAMGANGA RIVER, UTTARAKHAND[1]

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The length-weight relationship and condition factor of juvenile Golden Mahseer *Tor putitora* was observed from samples collected between November 2004 and May 2005, in the Khoh, Kolhu and Mandal rivers, tributaries of the Ramganga river, in Uttarakhand. Golden Mahseer found were mostly less than one year old. There was no significant difference found between rivers in respect of length-weight relationship and condition factor of Golden Mahseer. The estimated condition factor for Golden Mahseer across rivers was low (Kn = 1.10), however, the condition factor of larger fish in the samples was good.

Key words: rivers, length-weight relationship, condition factor, umbrella species

INTRODUCTION

Golden Mahseer *Tor putitora* (Hamilton 1822) belongs to the Family Cyprinidae. It has wide distribution all along the foothills of Himalaya. It also occurs in Nepal, Myanmar, Bangladesh, and Pakistan. Body size of fish is an important predictor for species diversity and density distribution (Knouft 2002; Ulrich 2004). The length-weight relationship is an important indicator for predicting gonadal development, metamorphosis, maturity, and condition of fish (Le Cren 1951). The length-weight relationship (L / W) has been widely used in fish biology with several purposes, e.g. to estimate the mean weight of the fish, based on known length (Bayer 1987), and weight as a function of length (Hile 1936). The condition factor Kn (Le Cren 1951) is a quantitative parameter for the well-being of fish and reflects recent feeding conditions. This factor varies according to influence of physiological factors fluctuating according to different stages of development. Anderson and Neumann (1996) refer to length-weight data of a population, as a basic parameter for monitoring study of fisheries, since it provides important information concerning the structure and function of populations. According to Le Cren (1951), the relative condition factor is affected by length as well as several other factors like environment, feeding and breeding.

Studies on spawning ecology (Nautiyal and Lal 1981), migratory behaviour (Nautiyal and Lal 1983) and length-weight relationship of Golden Mahseer (Nautiyal 1985a) have been carried out in the Garhwal Himalaya. Tributaries of the Ramganga river of lower Garhwal Himalayan region were identified as one of the important Mahseer areas (MacDonald 1936); however, there was no study on the ecology of the Golden Mahseer from this region. The objective here is to determine the length-weight relationship and variations in the condition factor of Golden Mahseer *Tor putitora* among different tributaries of the River Ramganga.

STUDY AREA

River Ramganga is one of the principal rivers of the Shivalik range or lower Garhwal Himalaya. Khoh, Kolhu, and Mandal are the tributaries of this river. Khoh originates from Dwarikhal in the north and drains through Shivalik ranges and is situated between 29° 45' 27"-29° 48' 22.1" N and 78° 32' 22.4"- 78° 36' 18.5" E in the southern part of the Pauri-Garhwal district of Uttarakhand state (Fig. 1). Kolhu is situated between 29° 41' 39.2"-29° 42' 46.3" N and 78° 31' 42.3"-78° 37' 41" E. Mandal is situated between 29° 35' 5"-29° 38' 9.9" N and 79° 00' 34.1"-78° 57' 9.7" E, rises in the eastern heights in Chamoli district and flows north to east of Corbett National Park, where it meets the Ramganga river.

MATERIAL AND METHODS

Survey of fish fauna in the tributaries of River Ramganga was carried out using a cast net having mesh size of 1 x 1 cm over a period of five months during December 2004 to April 2005. Sampling was carried out throughout the day. Collected fishes were placed in a bucket of water, and the total length (L) in cm, and body weight (W) to the nearest 0.1g were measured using Vernier caliper and pasola spring balance. After recording various morphometric characters, such as head length, body depth, eye diameter and total body length, the fishes were released back into the rivers.
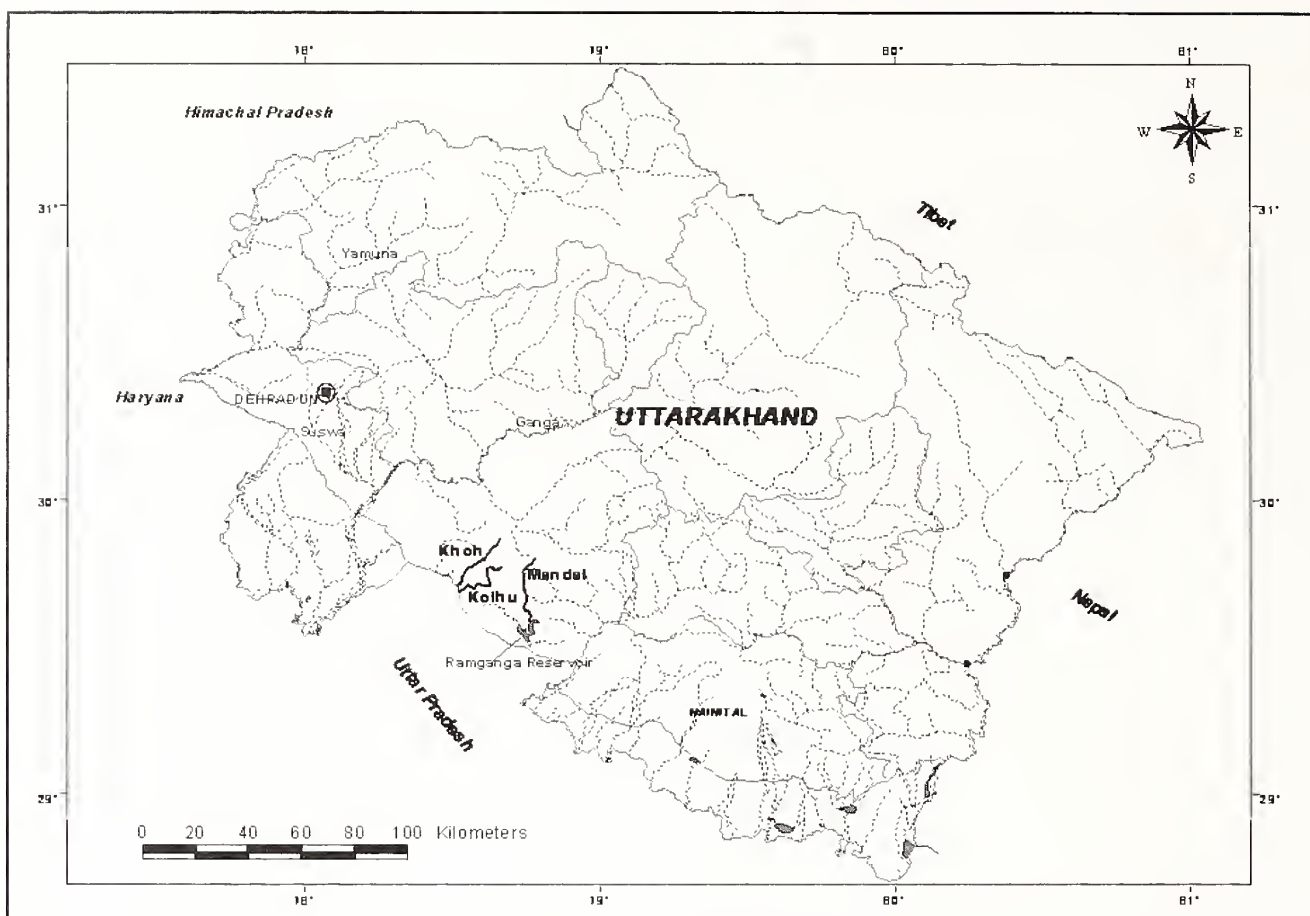
Fig. 1: Map of study river - Khoh, Kolhu and Mandal tributaries of the Ramganga river Uttarakhand, India

Length-weight relationship and condition factor were assessed from measurement of total weight (W) and total length (L). The general parabolic form of equation, $W = a L^b$, (where 'W' is weight of the fish in gm, 'L' is length in cm, 'a' is scaling constant, 'b' is allometric growth parameter) was used to show the statistical relationship between length and weight. Since the length-weight ratio is a power relationship, logarithms were used, so that the exponential relation could be expressed by a linear equation: Log W = log a + b log L. For each individual fish, regression was used to estimate the intercept (log a) and regression coefficient or slope b using SPSS (ver.8.0) programme.

Condition factor (Kn), assessed for comparisons among sites, was determined by the following expressions: $Kn = W/L^b$, where Kn corresponds to the condition factor and b is the allometry coefficient related with the form of the individuals growth, calculated from the length-weight relationship.

RESULTS

A total of 758 individuals were analyzed for length-weight relationship. The Golden Mahseer found were mostly

juveniles to subadults in these rivers. The size class of 6-10 cm (total length) was dominant in all three rivers followed by 11-15 cm; 26-30 cm and above were caught only in Kolhu river. The mean fresh total length were Log 0.891 ± SE 0.009 in Khoh (Fig. 2), Log 0.997 ± SE 0.024 in Kolhu (Fig. 3) and Log 0.844 ± SE 0.003 in Mandal rivers (Fig. 4). Similarly, mean fresh body weight were Log 0.895 ± SE 0.018, Log 1.097 ± SE 0.052,
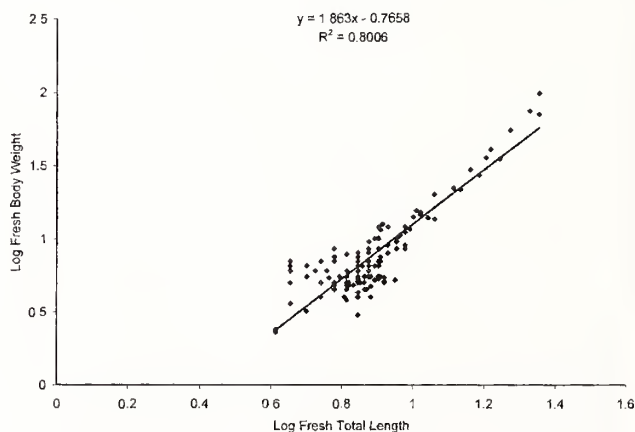
Fig. 2: Golden Mahseer in the Khoh river (n = 190)

162

J. Bombay Nat. Hist. Soc., 104 (2), May-Aug 2007

Table 1: Showing detail description of Golden Mahseer *Tor putitora* in the tributaries of the Ramganga river

River	n	r	b	a	Kn	Log ln ± SE	Log wt ±SE
Khoh	190	0.80	1.86	-0.76	1. 108	0.891 ± 0.009	0.895 ± 0.018
Kolhu	70	0.87	2.016	-0.91	1.103	0.997 ± 0.024	1.097 ± 0.052
Mandal	498	0.55	1.76	-0.66	1.105	0.844 ± 0.003	0.821 ± 0.008

n – number of individuals, r – regression value, b - allometric growth parameter, a - scaling constant, Kn – condition factor assessed for comparison among sites, ln – length of fish, wt – weight of the fish

and Log $0.821 \pm$ SE 0.008 respectively in these rivers.

There was no significant difference between rivers in respect of length-weight relationship of Golden Mahseer (One way ANOVA test, $F_{2,757} = 62.525$, P<0.095). The estimated regression coefficient, *b* was 1.863 in case of Khoh, 2.016 for Kolhu and 1.760 for Mandal rivers (see Figs. 2, 3, 4).

The condition factor of Golden Mahseer was better (i.e. Kn >3) in the size classes above 20-25 cm body length, but the condition factor of young ones, which were shorter than 20 cm in length, was poor and Kn value varied from 0.8 to 2.7 in these size classes. One-way ANOVA result shows that there were no differences in condition factor (Kn) of fishes in these three rivers ($F_{2,757} = 1.480$, p > 0.05, Table 1).

DISCUSSION

Tributaries of the Ramganga river of Lower Garhwal Himalaya were identified as one of the important mahseer areas (MacDonald 1936). However, the present study shows that upstream of River Ramganga, which largely falls in the buffer zone of the Corbett Tiger Reserve, Uttarakhand, also serves as an important spawning ground for the Golden Mahseer, as most of the fishes caught here were fingerlings and juveniles.

The length-weight relationship (W/L) and condition factor were observed for both the sexes of the Golden Mahseer

in the Beas River System (Bali and Sharma 2000). Length-weight relationship of Golden Mahseer in other parts of Garhwal Himalaya (Nautiyal 1985a) is different from those in the upstream of Ramganga tributaries. This may be due to the different environmental factors.

The estimated condition factor for Golden Mahseer across rivers was similar, i.e. Kn = 1.10. It is quite far removed from the ideal condition factor, i.e. Kn = 3. This ideal situation applies if the study was conducted throughout one complete breeding cycle of fish, which includes all size classes from juvenile to adult. We found that the majority of the Golden Mahseer individuals caught were in juvenile stage, as the sampling period was after the spawning season. The result shows that the condition factor of adult Golden Mahseer (Kn) was better than the juveniles in the upstream of the Ramganga river. Juveniles are normally slender with a maximum length to weight ratio resulting in low Kn value (Hile 1936). Condition factor observed was similar in all rivers, but different from the standard Kn value. Further, various anthropogenic disturbances (sand mining and indiscriminate fishing) were also observed in the Kolhu and Khoh rivers.

Golden Mahseer is well known for its delicacy, sport angling and most importantly it is an umbrella fish species in Himalayan streams. It is an endangered Himalayan fish under continuous threat due to various anthropogenic pressures
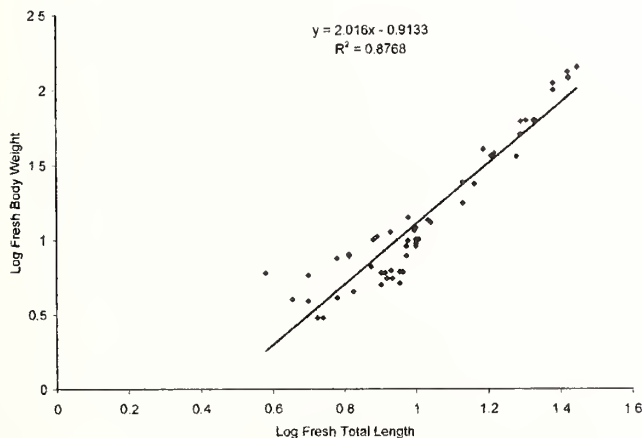

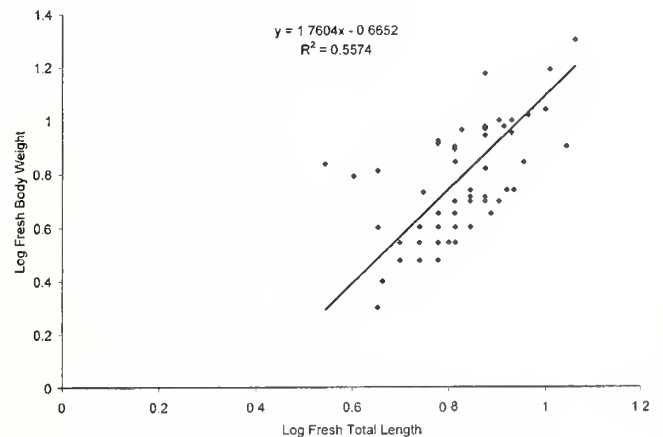Fig. 3: Golden Mahseer in the Kolhu river (n = 70)

Fig. 4: Golden Mahseer in the Mandal river (n = 498)

(Nautiyal 1985b). The tributaries of the River Ramganga provide a good spawning ground for the Golden Mahseer, and hence need immediate protection.

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164

J. Bombay Nat. Hist. Soc., 104 (2), May-Aug 2007